[white paper]

eicon
technology
corporation

Distributed Information:

Internetworking with IntranetWare

4th Quarter 1996

EICON TECHNOLOGY

Abstract

Eicon Technology is the leading provider of WAN and ISDN interface cards. Novell is the leading provider of network operating systems. Together, Eicon and Novell have brought to market a set of tools and technologies that allow customers to build intranets that span geographic boundaries and link to the global Internet.

The combination of Novell's excellence in NetWare-based communications services and Eicon's expertise in high-speed WAN communications hardware yields a range of superior connectivity solutions. LAN-LAN, LAN-Internet, remote access, and SNA connectivity solutions over media such as Frame Relay, ISDN, leased lines and X.25 are within reach of any corporate office.

This white paper introduces Wide Area Networking concepts, and shows how to use Novell NetWare/IntranetWare servers with Eicon WAN adapters to connect branch offices and remote users into an all-encompassing intranet, and how to link this intranet to external resources on the Internet.

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Table of Contents

Introduction

"Knowledge is power", Meditationes Sacræ De Hæresibus

The modern corporation lives and dies by information. Those that effectively distribute and act upon information gain competitive advantage. Those that don't will lose their edge.

Corporations have long lived by this truism. In the 1970s, workers used terminals to access information stored on a mainframe. In the 1980s, the development of LANs allowed data to be shared between PCs. Today, NetWare connects over 40 million users worldwide.

In its simplest incarnation, NetWare supports *local* area networking, distributing information among users located within a single site. It also leads to the formation of information 'islands'—geographic entities that do not communicate efficiently with one another. To distribute information across geographical boundaries, Novell introduced IntranetWare, the evolution of NetWare to a network operating system (NOS) that includes wide area networking services. These services integrate information from branch offices and remote users along with worldwide web, SNA, and other disparate data into a single corporate knowledge-base often referred to as the intranet. These same services also allow corporations to link to external knowledge bases through the Internet.

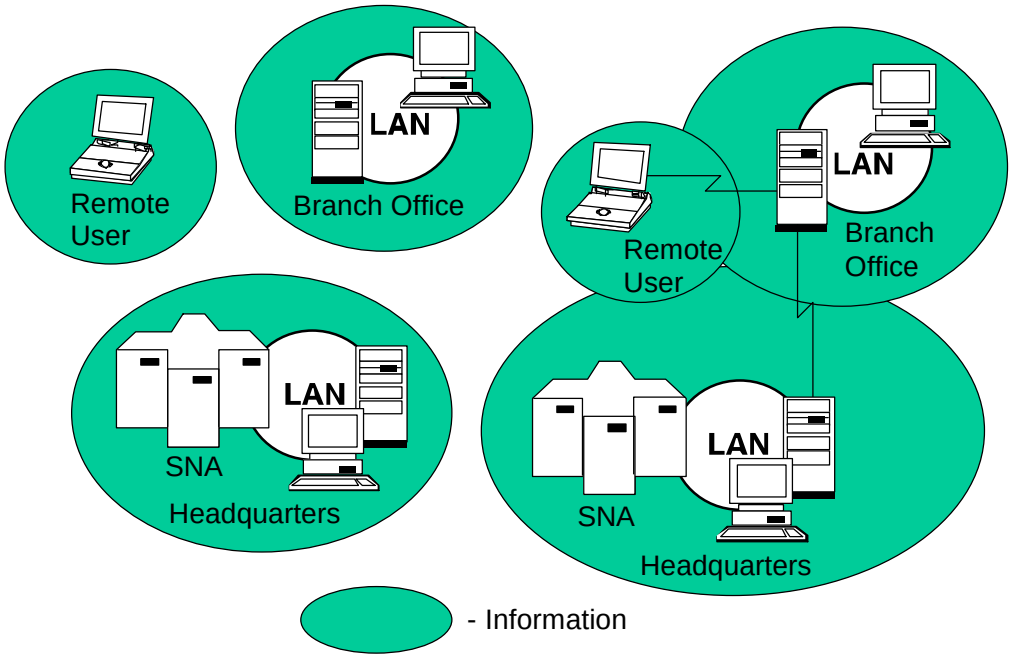


Figure 1: The effect of connectivity on knowledge distribution

These WAN services are provided by IntranetWare, NetWare Connect, and NetWare for SAA. All can be run on a single IntranetWare server, and, with the appropriate Eicon Technology WAN/ISDN adapter, assist corporations in efficiently distributing information.

Wide Area Networking with IntranetWare

"I hope if dogs ever take over the world, and they chose a king, they don't just go by size, because I bet there are some Chihuahuas with some good ideas", Deep Thoughts, Jack Handey

All kidding aside, efficiently distributing information is important no matter how small a branch office, or how remote a telecommuter. The wide area networking services this paper describes can be installed in NetWare/IntranetWare servers already present in most branch offices—the same servers which provide local networking services. Unlike box-based alternatives, these server-based solutions can be managed by anyone familiar with NetWare, and can be easily customized to suit specific needs. As WAN requirements grow, new software, new WAN adapters, and/or new server hardware can be added to meet evolving needs. Server-based wide-area networking is the only logical approach to branch office connectivity.

LAN-to-LAN and LAN-to-Internet Connectivity

IntranetWare is Novell's new distributed networking platform, capable of connecting branch office LANs into the corporate intranet and to the Internet. By integrating routing technology into the NOS, it obviates the need for an external box router, and enables cross-enterprise e-mail or World Wide Web applications. IntranetWare supports IPX, IP, AppleTalk, Source Route Bridge (SRB), and DLSw traffic and is interoperable with third-party routers. It supports link state routing protocols such as OSPF and NLSP, and offers bandwidth-optimizing features such as IPX spoofing, compression, and advanced filtering. Used with Eicon Technology WAN adapters, IntranetWare can connect over ISDN, Frame Relay, leased lines, X.25, and plain old telephone system (POTS) networks, and can even back up permanent links with ISDN. For customers who haven't upgraded to IntranetWare, NetWare MultiProtocol Router can be installed on existing NetWare servers.

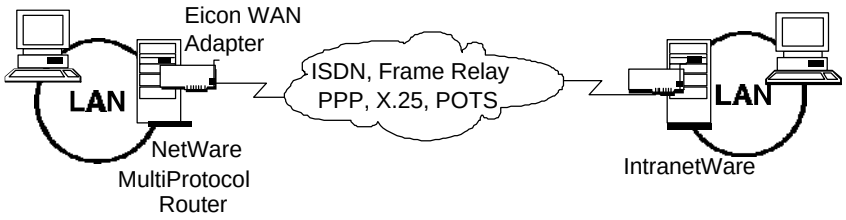


Figure 2: LAN - LAN Intranetworking

IntranetWare also includes NetWare Web Server and IPX/IP gateway technology, making it a very complete Internet platform. These technologies allow corporate networks to easily access and/or serve information across the Internet.

Figure 3: LAN - Internet Connectivity

Remote Access

Novell's NetWare Connect technology is one of the most powerful and most popular means of providing remote users with access to the corporate intranet. Using NetWare Connect, remote users can securely dial into a LAN and access corporate information as if locally attached to the network. NetWare Connect simplifies configuration via NDS support, and provides management facilities via ConnectView software. Used with Eicon Technology's high-speed ISDN and WAN adapters, it supports dial-up remote access via ISDN and X.25 networks.

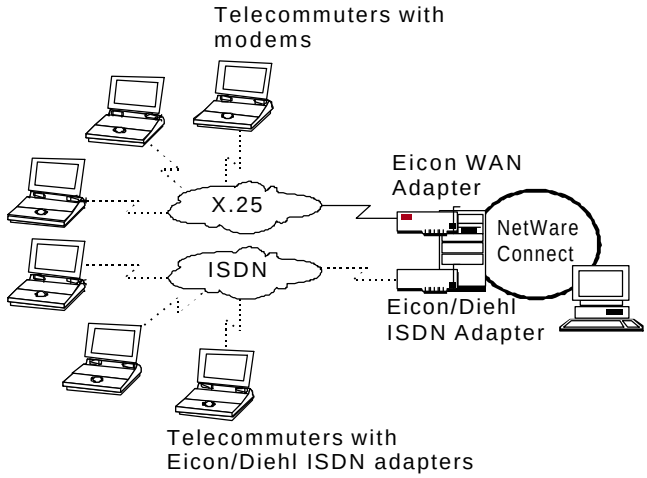


Figure 4: Remote LAN Access

NetWare to SNA Hosts

NetWare for SAA is currently the market leader for NetWare access to SNA hosts, enabling users on branch office LANs to access information stored on SNA mainframe and midrange systems. NetWare for SAA supports 3270 and 5250 connectivity via a wide range of desktop emulators including Eicon's Access for Windows, and can connect LANs over SDLC and X.25 networks using Eicon Technology WAN adapters.

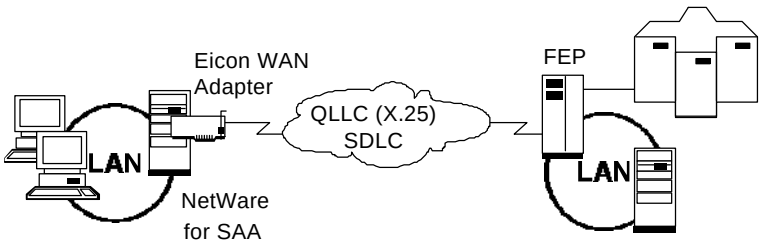


Figure 5: Branch LAN to SNA Connectivity

To summarize, NetWare is a powerful NOS able to connect *all* the diverse components of an enterprise network. These services are provided by the following technologies:

LAN - LAN and LAN - Internet	Remote Access	LAN - SNA Host
Included with IntranetWare (NetWare MultiProtocol Router can be added to NetWare)	NetWare Connect	NetWare for SAA

WAN Media

'A little learning is a dangerous thing;', Alexander Pope

Corporations considering intranet/Internet connectivity must first decide on the appropriate WAN medium. This can be a complex decision, as there are numerous affordable, reliable options, including standard telephone lines, digital communications lines, switched or permanent links, and packet or circuit-switched connections. This section *introduces*, in a general way, some common WAN technologies.

The key to choosing the optimal WAN medium is to understand the specific requirements of the application(s) it must support. Some issues to consider are:

- What is the application? LAN traffic often requires permanent high bandwidth connections. Remote access requires an intermediate-speed dial-up medium, while LAN access to SNA hosts is typically used for mission critical applications requiring extremely reliable but lower-speed connections.
- How many locations are involved and where are they? Certain media become more, or less cost-effective depending on how meshed the network is, and how far apart offices are. Depending on where a branch is located, certain WAN media may not be available, particularly in countries with an outdated communications infrastructure.
- What are the traffic patterns? Only certain networks can handle bursty LAN traffic. Also, the cost of some media varies with usage, making the medium overly expensive for high traffic links. Moreover, usage fees may vary according to the time the link is used; for example, costs may increase during business hours, which would be impractical for certain applications.

Answers to the above questions should help narrow the choice of WAN media. Some of the options available today include:

POTS

The "Plain Old Telephone System" (POTS) is useful when limited bandwidth - up to 33.6 Kbps - is needed for periodic connections. Applications using this medium include telecommuting and low-speed backup of LAN-LAN links. POTS is best suited for local connections. It is less useful over long distances due to diminishing reliability, reduced connection speeds, and increasing costs.

ISDN

ISDN can be thought of as the evolution of POTS; instead of forming low-speed analog connections, ISDN enables faster, more reliable digital connections over the existing telephony infrastructure. ISDN lines are available in a number of configurations with Basic Rate Interfaces (BRI) supporting two 64 Kbps connections, and Primary Rate Interfaces (PRI) supporting up to 30 such connections (23 in North America & Japan). The increased speed, low latency, and reliability of ISDN make it suitable for a wide range of dial-up networking applications, including remote access and LAN-LAN or LAN-Internet connections. Like POTS, ISDN pricing is usually both usage- and distance-sensitive, making it most cost-effective for low-volume applications requiring local calls, or as a backup to permanent LAN connections.

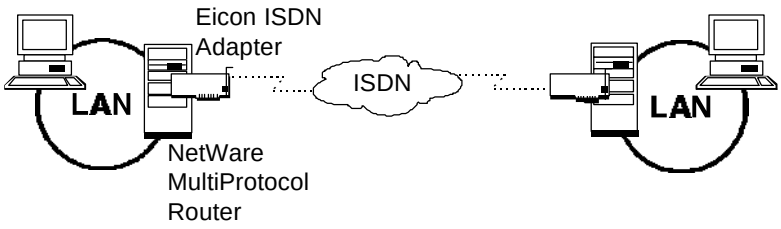


Figure 6: LAN - LAN Connectivity over ISDN

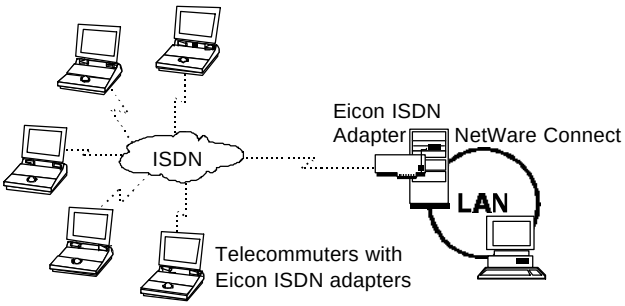


Figure 7: Remote Access over ISDN

Leased lines

Leased lines continue to remain one of the most popular intranet WAN media for large corporations, especially in North America. Because a leased line is a permanent link between two sites, it can only be used for LAN-LAN connections (using PPP) or LAN-SNA host connections (using SDLC). But leased lines are unparalleled in performance for these applications. Leased lines support transmission speeds ranging from 19.2 Kbps to T3 (45 Mbps), and provide 99.99% uptime in North America. As dedicated permanent links, they are more secure than other WAN alternatives and are suitable for almost any type of traffic.

The disadvantage of leased line connections is expense. Pricing is distance-sensitive, and leased lines always cost more than any alternative providing the same bandwidth. Leased lines are unreliable in some regions, and failures—although rare—can take hours to resolve if a backup link has not been prepared.

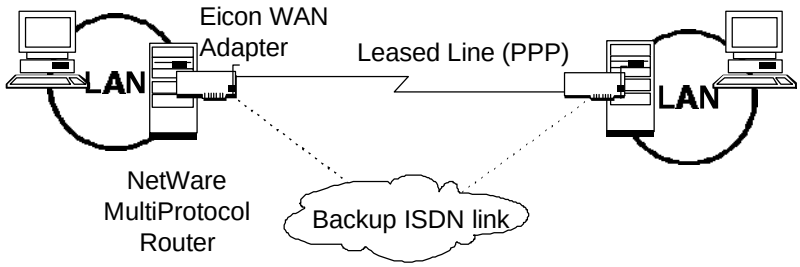


Figure 8: LAN - LAN Connections over Leased Lines

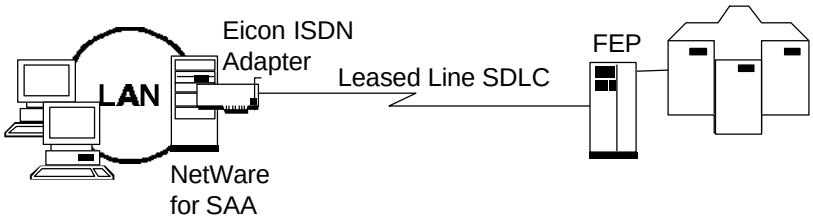


Figure 9: LAN - SNA Connectivity over Leased Lines

X.25

Packet-switched networks have long been an alternative to the direct connections described above, with X.25 being the most mature of these alternatives. Packet-switched connections are “virtual”, in that connected sites are not physically linked. Whereas POTS, ISDN and leased lines are analogous to a direct pipeline between two sites, a packet-switched service is analogous to a delivery service sending packages between sites via intermediate hubs and couriers (in other words, via the X.25 network). For this reason, a single physical link to the X.25 network can support multiple concurrent connections to different sites.

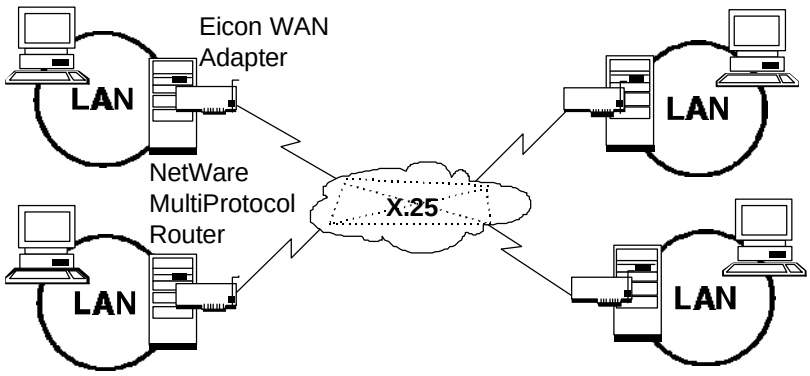


Figure 10: Meshed LAN - LAN Connectivity over X.25

X.25 is available almost universally, supporting transmission speeds ranging from 9.6 Kbps to 256 Kbps, with guaranteed global delivery. Because X.25 is a mature technology, it supports numerous access methods. You can connect to an X.25 network through a dial-up telephone link, ISDN, or a dedicated line. X.25 pricing is usage-based, but not very distance-sensitive. Over long-distances, it is far less expensive than a direct POTS, ISDN or leased-line connection. These characteristics make X.25 suitable for both LAN-LAN and LAN-SNA host connections—especially for global corporations which need reliability and universal availability. X.25 is not, however, suited to high-bandwidth applications, especially those sensitive to the high latency introduced by X.25 networks.

X.25 is also suitable for remote user connectivity. Remote users worldwide can simply dial into a local X.25 networks using a standard modem. The X.25 service provider’s Packet Assembler/ Disassembler (PAD), converts the asynchronous data stream coming from the modem into X.25 packets. This enables *affordable* and *reliable* remote access to corporate LANs from anywhere in the world.

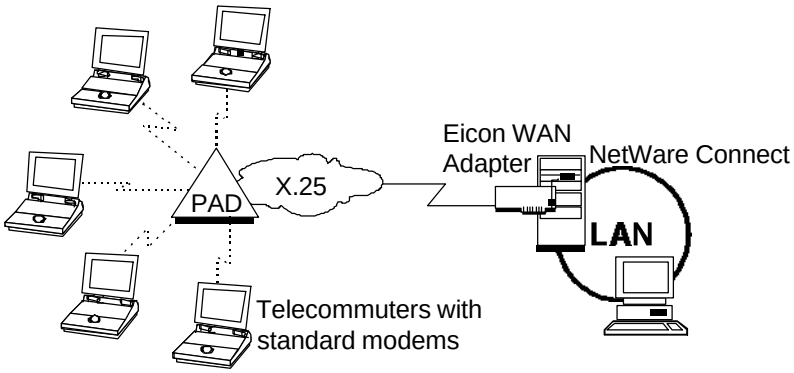


Figure 11: Remote Access over Global X.25 Networks

Frame Relay

Frame Relay is an up-and-coming packet-switched service which has already nudged out many leased lines for LAN-LAN intranetworks. It can be viewed as a streamlined version of X.25. It thus offers greater speed and reduced latencies, at the cost of less error-checking. Frame Relay availability is steadily growing, however, it may not be available in countries with unreliable communications infrastructures (in which case X.25, with its advanced error-checking, will usually be available). Frame Relay usually costs less than a leased line of equivalent bandwidth, and becomes even less expensive over longer distances. Applications requiring meshed connectivity are especially cost-effective using Frame Relay, since multiple virtual connections can exist on a single physical link. An added benefit of Frame Relay over leased lines is that bursts in traffic above the subscribed bandwidth are permitted.

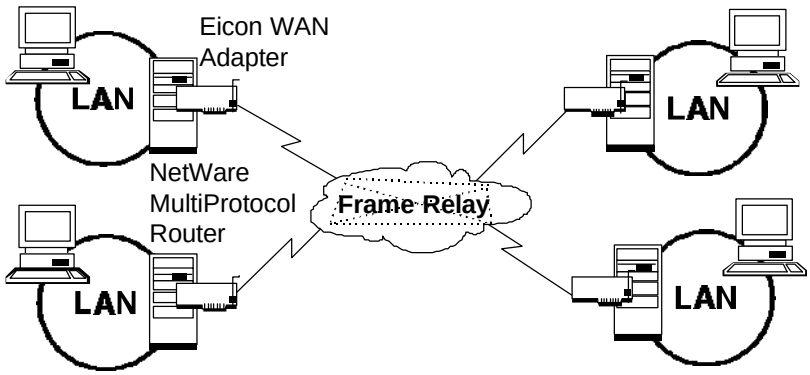


Figure 12: Meshed LAN - LAN Connectivity over Frame Relay

Frame Relay is also increasingly being used for Internet connectivity, and growing confidence is making it a popular choice for SNA access. It is also gaining favor for remote access, as service providers begin to offer dial-up access into Frame Relay networks via POTS and ISDN. ISDN access into Frame Relay networks will also enable them to easily back up the permanent Frame Relay links currently in use. It seems likely that Frame Relay will eventually enjoy the same degree of flexibility as X.25 provides today.

XDSL and ATM

As the use of multimedia over WAN links becomes more prevalent, corporations' thirst for bandwidth is increasing. Research into technologies such as Asymmetric Digital Subscriber Loop, Symmetric Digital Subscriber Loop, and/or Asynchronous Transfer Mode are yielding viable WAN alternatives that will eventually meet this need. XDSL technologies will permit data transfers at the rate of Megabits per second over the existing telephony infrastructure, while ATM will eventually seamlessly transfer voice and data over a digital communications infrastructure. Today, these technologies are rarely available and do not offer any compelling reasons for migration. Nonetheless, these technologies are just in their infancy, and will continue to rapidly advance. Network managers would be well advised to pay close attention to them, given the high-bandwidth benefits they will eventually yield.

In summary, the wide range of choices available today make selecting a WAN media a complex decision. The following table summarizes the information discussed above:

		Suitability to Task			
Medium	**Characteristics**	LAN-LAN	LAN-Internet	Remote Access	LAN-SNA
POTS	Dial-up, slow (33.6 Kbps max.) Unreliable over long distances Distance- and usage-sensitive pricing	✓ (main link) ✓✓ (backup)	✓	✓✓	
ISDN	Dial-up, fast (64 Kbps channels) Reliable over long distances Distance- and usage-sensitive pricing	✓✓✓ (main link) ✓✓✓ (backup)	✓✓✓	✓✓✓✓	
Leased line	Permanent, fast (T3) Reliable over long distances Expensive, bandwidth- and distance-sensitive pricing	✓✓✓ (main link)			✓✓✓✓
Frame Relay	Usually permanent, fast (T3) Reliable over long distances Cheap, bandwidth-sensitive pricing	✓✓✓✓ (main link) ✓✓✓ (backup)	✓✓✓		✓✓✓✓
X.25	Switched or permanent, fast (128 Kbps) Very reliable worldwide Bandwidth- and usage-sensitive pricing	✓✓✓ (main link)	✓	✓✓✓	✓✓✓

WAN Adapter Choices

After deciding on a WAN medium, corporate administrators must decide what type of WAN adapter to use in their NetWare server. This is similar to deciding on a LAN adapter. For instance, if a corporation is using 100 Mbps workstation LAN adapters, it makes sense to choose server LAN adapters capable of handling the same throughput—taking into account factors which may affect server utilization such as the adapter bus type. Similarly, several factors will affect the choice of WAN adapter:

- What protocol is being used? Certain WAN adapters are better for processing certain protocols.
- What are the bandwidth requirements? Different WAN adapters have different bandwidth capacities.
- Will the communications server also be used for file services? Some WAN adapters consume more server resources than others.
- Are there any certification requirements? X.25 and Frame Relay networks may require that the adapter connecting to them be certified. Not all WAN adapters are.

Passive WAN adapters

Passive WAN adapters—such as Eicon Technology's P-series adapters—are those which do not perform any protocol processing. Passive adapters provide only synchronous framing services, and rely on the server to run a WAN protocol stack such as SDLC, PPP, Frame Relay, or X.25. Despite their moniker, passive adapters offer the highest performance of any adapter for leased line connections using PPP or SDLC. This is because PPP and SDLC protocols have so little overhead associated with them that the server can process the data faster than it could transfer the data to an intelligent adapter for processing.

When used with higher overhead protocols such as X.25 or Frame Relay, passive adapters increase server utilization significantly. This can become a problem when using a single server for both file services and communications services (for example, in a branch office). Another potential disadvantage of passive adapters is that they cannot be certified for legal use on many public X.25 networks (since the X.25 protocol is running on the server, not on the adapter).

Intelligent Multiservice WAN adapters

Intelligent multiservice WAN adapters—such as the EiconCard S51—perform all WAN protocol processing. When using processing-intensive protocols such as X.25 and Frame Relay, this reduces server utilization by over 50%, compared to passive adapters. Intelligent adapters can also perform data compression, further reducing server utilization. And because protocol processing is done on the adapter, intelligent WAN adapters are certifiable and can be legally used on networks worldwide.

Intelligent multiservice adapters support a wider range of connections than passive adapters. Along with X.25, Frame Relay, PPP, and SDLC, they can connect over ISDN lines. This makes them ideal for applications involving multiple WAN media; for example, a high-speed permanent connection with ISDN backup.

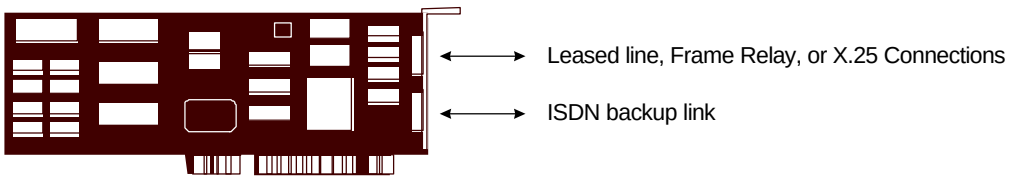


Figure 13: ISDN Backup on Multiservice Adapters

Intelligent adapters are less cost-effective for certain applications, particularly leased line connections. For instance, high-speed PPP connections are better served by a passive WAN adapter, as are NetWare for SAA-based SDLC connections. Applications requiring ISDN only, are better served by the ISDN WAN adapters described below. Intelligent multiservice adapters are optimally used for X.25 or Frame Relay, and when combinations of these protocols and others are required.

ISDN adapters

With the increasing global availability of ISDN, there is growing demand for ISDN WAN adapters to handle both LAN-LAN and remote access connectivity. ISDN adapters are available with different combinations of ports and ISDN connection types. They are the optimal adapter type whenever ISDN is the *only* type of WAN connection being used.

Server-based ISDN adapters handle all ISDN protocol processing. These adapters are available in a number of different configurations, some supporting a single BRI, others supporting multiple BRIs, and still others supporting high speed PRI connections.

Client-based ISDN adapters can only connect to a BRI, but are also available in the smaller PC-card (PCMCIA) format.

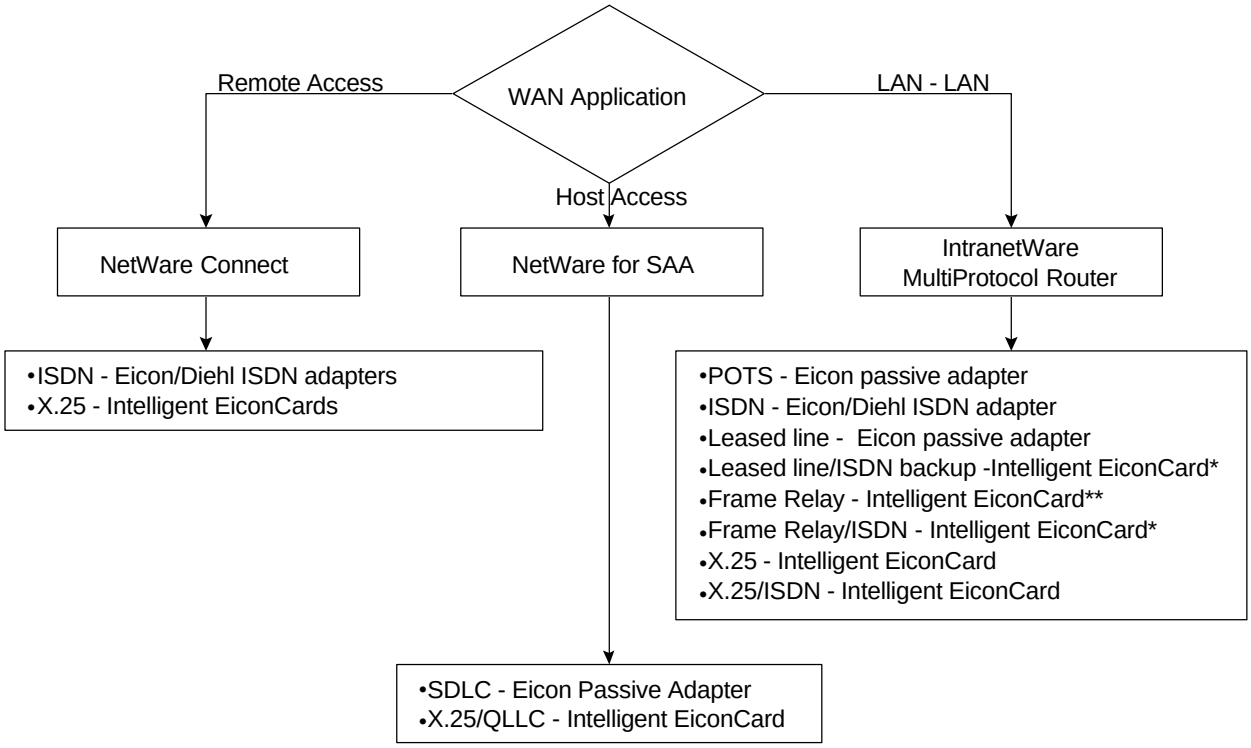
In summary, Eicon Technology offers a range of WAN adapters that will meet your varying requirements. NetWare connectivity is enabled via Eicon's sophisticated NetWare drivers that are used in conjunction with these adapters. The following table summarizes which adapters can be used with which NetWare WAN services. Protocols that are highlighted indicate that the associated adapter is optimized for that protocol.

	IntranetWare/ NetWare MPR 3.x	NetWare Connect 2.0	NetWare for SAA 2.x
P-series adapter	✓ (POTS, **PPP**, Frame Relay, X.25)	✓ (X.25)	✓ (X.25/QLLC, **SDLC**)
Intelligent Multiservice adapters	✓† (PPP, **Frame Relay**, **X.25**, **ISDN/X.25**, **ISDN/Frame Relay**, **backup ISDN**)	✓ (**X.25**)	✓ (**X.25/QLLC**)
ISDN adapters	✓ (**ISDN**)	✓ (**ISDN/PPP**)	

† *Frame Relay and PPP support available Q1 '97 for Intelligent MultiService Adapters*

Eicon's WAN Solutions for NetWare

So far, much has been said about wide area networking services for the NetWare platform. This paper has discussed available WAN media and summarized the pros and cons of different WAN adapters. This section summarizes this information in terms of the *recommended products*that will provide you with the solutions you need for any given application and WAN media (although many other solutions are supported, as indicated in the previous table):



** Frame Relay/ISDN and Leased line support in Q1 '97*

*** Frame Relay support in Q1 '97, until then use Eicon passive adapter*

In order to use Eicon Technology WAN adapters with NetWare WAN services, you will need to use Eicon WAN drivers to provide the necessary protocols/interface to NetWare. A number of different drivers are available, depending on the specific functionality you require. This information is summarized in the following table:

Driver(s)	Description	Source(s)
PacketBlaster driver for NetWare/ IntranetWare	Interfaces the PacketBlaster adapter to IntranetWare, MPR 3.x, NWC 2.0, and NW for SAA 2.x	Connections for NetWare, IntranetWare, MPR 3.1, NW for SAA 2.2, PacketBlaster adapter, www.eicon.com
Intelligent EiconCard driver for NetWare/ IntranetWare	Interfaces intelligent EiconCards such as EC PC, EC PC/HSI, and EC S51 to IntranetWare, MPR 3.x, NWC 2.0, and NW for SAA 2.x	Connections for NetWare, NW for SAA 2.2, www.eicon.com
ISDN Driver for NetWare MultiProtocol Router	Interfaces intelligent ISDN adapters such as Scom, Quadro, S2m to MPR 3.x. Provides ISDN bandwidth optimization.	Connections for NetWare, www.eicon.com
ISDN Drivers for NetWare Connect	Interfaces intelligent ISDN adapters such as Scom, Quadro, S2m to NWC 2.0, and interfaces DIVA to NWC 2.0 clients.	Connections for NetWare, www.eicon.com
CAPI ISDN drivers for NetWare/ IntranetWare	Interfaces intelligent ISDN adapters such as Scom, Quadro, S2m to IntranetWare and MPR 3.1.	IntranetWare, MPR 3.1, Connections for NetWare, www.eicon.com

All of the drivers that you may require for NetWare Connectivity are available at no cost. In most cases, you can simply purchase NetWare software and an Eicon WAN adapter, and if necessary, obtain the latest drivers for that adapter. For your convenience, all drivers will be regularly updated on the Connections for NetWare CD which can be purchased at a nominal cost, or alternatively, they can be downloaded from www.eicon.com. Eventually, all Eicon drivers will be included with Novell's WAN software, as is presently the case with Eicon drivers included with IntranetWare, and NetWare for SAA.

For your convenience, Eicon also resells NetWare MultiProtocol Router software for NetWare users that are not upgrading to IntranetWare. Eicon also provides IntranetWare customers with enhancement kits that bundle 36-port licenses for IntranetWare with Eicon ISDN adapters (IntranetWare, by default, supports only one port, and consequently only a single ISDN B-channel may be used).

With this broad range of hardware/software support, Eicon Technology will be able to meet whatever NetWare connectivity requirements you may have.

Conclusion

Wide area networking is one of the cornerstones of effective information distribution, enabling the formation of intranets that extend across geographic boundaries and link to external Internet resources. Corporations that invest in these technologies today are adding another weapon to their arsenal of knowledge-based tools, and gaining a long term competitive advantage.

Eicon Technology and Novell are continually working together to ensure that NetWare customers will continue to be the recipients of cutting-edge, yet practical technology. Eicon is continuing to refine the power and speed of its Wide Area Networking hardware and software, while Novell is seeking to deliver more power and ease-of-use by combining all of its Wide Area Networking services into a single package, as part of the IntranetWare initiative.

The daunting prospect of connecting diverse resources into a single network is simpler than it first appears. While many factors must be considered, solutions from Eicon Technology and Novell are ready and waiting to be implemented. Eicon Technology is your partner in helping you to leverage the power of distributed information.

Glossary

AppleTalk
The suite of protocols that allows Apple Computer hardware and software on an AppleTalk network to interact and route data.

Basic Rate Interface
One of several defined user interfaces between an ISDN device and the ISDN switch. The basic rate interface is comprised of two B-channels (64 Kbps each) and one D-channel (16 Kbps), providing a user data rate of 144 Kbps.

B-channel
Bearer services are carried on the B-channel at the rate of 64 Kbps. Since ISDN protocols do not specify the format of this data, literally any service may be transmitted over the B-channel, including voice, video, audio, and data signals.

Circuit-switching
A physical circuit is established on demand between two communications devices and maintained exclusively for their use until the call is terminated. Public telephone networks are circuit-switched.

Compression
A process whereby the effective throughput is increased by encoding data in such a way that fewer bits are required to represent it. For example, a text file might be compressed by representing common words with single characters; thus if the word “the” is represented by “@”, it will be transmitted three times faster. Popular compression algorithms typically reduce the size of the data by 50%, effectively doubling the rate at which it is transmitted.

Customer Premises Equipment (CPE)
Equipment installed at an individual user’s home or business, and capable of attaching to a telecommunications service provider’s network. A telephone, PC, and fax machine are examples of CPE.

Data Link Switching (DLSw)
A protocol designed to encapsulate SNA and NetBIOS traffic within IP or IPX packets.

D-channel
Signaling messages sent between the ISDN device and the ISDN network are always carried on the D-channel at the rate of 16 Kbps for the basic rate interface, and at 64 Kbps for primary rate interfaces. These include requests to set up a call to another ISDN device and information about the type and number of B-channels to be used. In some implementations of ISDN, unused bandwidth on the D-channel can also carry low-priority X.25 packets at a typical throughput of 4-8 Kbps.

Filtering
The process on communications equipment that selectively discards packets of a certain type, or packets originating from or destined for a certain location.

Frame Relay
A high speed, multiplexing protocol designed to take advantage of the very low incidence of errors on digital and fiber circuits. Conceptually, Frame Relay is similar to X.25 with up to 80% less internode error-checking, and with a correspondingly higher transmission rate. Responsibility for flow control, sequencing, additional error detection, and all error correction is assumed by the end-user (more specifically, by the higher layer protocols— transport through application—in the OSI reference model).

ISDN
Integrated Services Digital Network. The term ISDN describes (1) the collection of protocols, functional devices, and interfaces between them used to implement a network capable of providing end-to-end digital connectivity, and (2) the interface through which a user accesses digital services available on such a network. The user-network interface specifies the number of data channels available, their transmission speed, and the signaling protocol used to set up and maintain calls.

Meshed Network
A network in which each node on the network is directly connected to every other node on the network.

OSI Reference Model
Open System Interconnection Reference Model. A networking model developed by the International Organization for Standardization (ISO). The OSI model divides data transmission into seven discrete but interacting levels, or layers, each with its own protocols and standards. Each layer is responsible for a different aspect of moving a block of data over a network. From 1 to 7, the layers are: physical, data link, network, transport, session, presentation, and application.

NetWare Directory Services (NDS)
A set of services included with NetWare 4.1 that enables network resources to be centrally administered and secured.

NetWare Link Services Protocol (NLSP)
The link state protocol used by IPX routers and servers to share information about their routes with other devices on the network. NLSP enables network managers to interconnect small or large IPX networks without routing inefficiencies.

Open Shortest Path First Protocol (OSPF)
A hierarchical Interior Gateway Protocol routing algorithm for IP that is a proposed standard for the Internet. Incorporates least-cost routing, equal-cost routing, and load balancing.

Packet Switching
Packet switching is a means of data transmission that segments traffic into discrete packets, each containing its own addressing and control information. These data “packets” are routed through nodes on the network toward their destination, where they are reassembled into the original block of data. Packet-switching allows multiple users to simultaneously share the same physical transmission lines; but it is unsuitable for time-sensitive applications because the rate of throughput is not guaranteed.

Point to Point Protocol (PPP)
An industry-standard protocol that enables point-to-point transmissions of routed data across transmission facilities between interconnected LANs using a synchronous or asynchronous serial interface.

Primary Rate Interface
One of several defined user interfaces between an ISDN device and the ISDN switch. The primary rate interface is comprised of 23 or 30 B-channels (64 Kbps each) and one D-channel (64 Kbps), providing a user data rate of 1.544 Mbps or 2.048 Mbps.

Protocol
A collection of procedures, data formats, and rules used to describe how two devices communicating at a peer level will understand one another. Different protocols are needed at every level of data transmission, from defining the specific electrical signal signifying a bit to sharing data in a sophisticated manner between applications.

Rate Adaptation
Also Rate Adaption. The process of converting a user’s actual bit rate, which may be 56 Kbps synchronous or 9.6 Kbps asynchronous, to the 64 Kbps speed of the B-channel.

Source Route Bridging
A bridging scheme proposed by IBM that merges the two most prevalent bridging strategies (source route bridging and transparent bridging). It employs both technologies in one device. No translation is done between the bridging protocols.

Spoofing
A technique used to mimic server and/or client protocol processes locally, so that these overhead processes do not result in the transmission of overhead over the WAN.

Synchronous Data-Link Control Protocol (SDLC)
A bit-oriented synchronous data-link protocol developed by IBM as a link-access technique for Systems Network Architecture (SNA) networks.

Systems Network Architecture (SNA)
The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through IBM mainframe or midrange-centric networks.

Terminal Adapter (TA)
The ISDN CPE device which allows non-ISDN equipment to be attached to ISDN networks.

Virtual Circuit
Refers to a switched circuit emulated by a packet-switched network. A permanent virtual circuit is characterized by its namesake, while switched virtual circuits form for the duration of a call.

X.25
A packet-switching protocol defined by the CCITT, X.25 is designed to carry high volumes of data with no errors. More specifically, X.25 defines the interface between user data terminal equipment and the packet-switching network equipment.

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